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Bosscher et al.

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(54) **STACKABLE, MAGNETICALLY-RETAINED CONNECTOR INTERFACE**

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,521,216 A * 7/1970 Tolegian H01R 13/6205
439/152
3,808,577 A * 4/1974 Mathauser H01R 13/6205
439/180

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1941705 4/2007
CN 202405510 8/2012

(Continued)

OTHER PUBLICATIONS

Extended European Search Report for European application No. 16167290.2 dated Aug. 5, 2016, 8 pages.

(Continued)

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(57) **ABSTRACT**

A stackable connector interface with magnetic retention for electronic devices and accessories can allow power and data to be transferred between one or more stacked connectors. Each interconnected stackable connector includes one or more magnetic elements, which magnetic elements have poles arranged to facilitate mating with other stackable connectors. The magnetic elements provide a magnetic retention force that holds mated connectors in contact with each other. In some embodiments, the connectors include connection detection circuitry for determining whether the connectors are mated with other connectors, thereby allowing the connectors to prevent live contacts from being exposed at an unmated surface of the connectors. In some embodiments, routing circuitry is included to determine how signals should be transferred between the interconnected stackable connectors and/or corresponding devices.

18 Claims, 17 Drawing Sheets

